



PCT
WELTORGANISATION FÜR GEISTIGES EIGENTUM
Internationales Büro
INTERNATIONALE ANMELDUNG VERÖFFENTLICHT NACH DEM VERTRAG ÜBER DIE
INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)

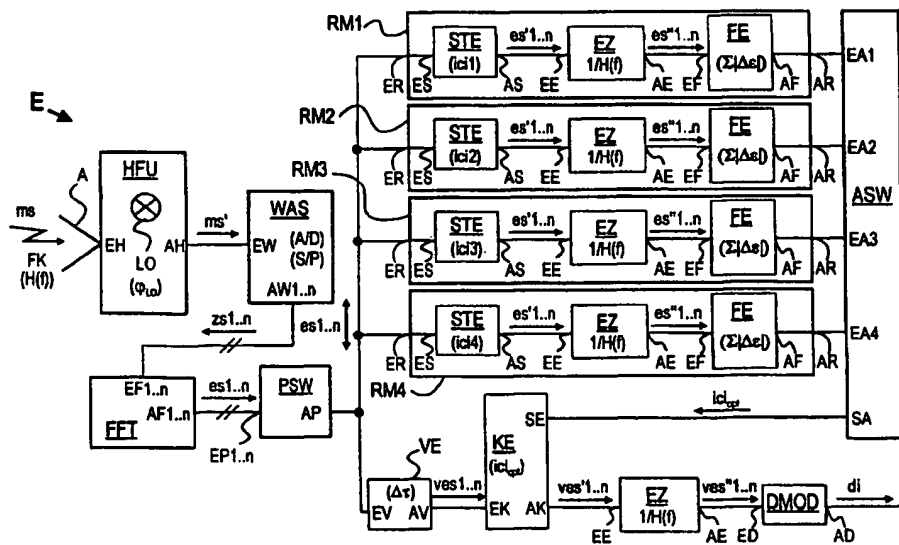
(51) Internationale Patentklassifikation ⁷ : H04L 27/26, 25/03	A1	(11) Internationale Veröffentlichungsnummer: WO 00/60822 (43) Internationales Veröffentlichungsdatum: 12. Oktober 2000 (12.10.00)
(21) Internationales Aktenzeichen: PCT/DE00/00699 (22) Internationales Anmeldedatum: 6. März 2000 (06.03.00) (30) Prioritätsdaten: 199 14 797.3 31. März 1999 (31.03.99) DE (71) Anmelder (für alle Bestimmungsstaaten ausser US): SIEMENS AKTIENGESELLSCHAFT [DE/DE]; Wittelsbacherplatz 2, D-80333 München (DE). (72) Erfinder; und (75) Erfinder/Anmelder (nur für US): ZIRWAS, Wolfgang [DE/DE]; Mittenwalder Strasse 136, D-82194 Gröbenzell (DE). (74) Gemeinsamer Vertreter: SIEMENS AKTIENGE- SELLSCHAFT; Postfach 22 16 34, D-80506 München (DE).	(81) Bestimmungsstaaten: CN, JP, US, europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Veröffentlicht <i>Mit internationalem Recherchenbericht. Vor Ablauf der für Änderungen der Ansprüche zugelassenen Frist; Veröffentlichung wird wiederholt falls Änderungen eintreffen.</i>	

(54) Title: METHOD, USE OF SAID METHOD AND RECEIVER SYSTEM FOR RECEIVING MULTI-CARRIER SIGNALS PRESENTING SEVERAL FREQUENCY-DISCRETE SUBCARRIERS

(54) Bezeichnung: VERFAHREN, VERWENDUNG DES VERFAHRENS UND EMPFANGSANORDNUNG ZUM EMPFANG VON MEHRERE FREQUENZDISKRETE SUBTRÄGER AUFWEISENDEN MULTITRÄGERSIGNALEN

(57) Abstract

In a received multi-carrier signal (ms) which presents subcarrier-specific interference (ici0) caused by adjacent subcarriers (st1...n) said subcarriers (st1...n) are additionally subjected to interference in a targeted manner and a correction information (iciopt) which represents the subcarrier-specific interference (ici0) is derived from the subcarriers (st1...n). The received subcarriers (st1...n) are then corrected by means of the correction information. Low-cost oscillators can advantageously be used to produce economical transmitter and receiver units.



Patent Claims

1. A method for receiving a multicarrier signal (ms) having a number of frequency-discrete subcarriers (st1...n) and into which information is inserted which is converted by means of a multicarrier method to frequency-discrete modulation-specific modulation symbols with the individual frequency-discrete subcarriers (st1...n) of the multicarrier signal (ms) transmitted via a transmission medium (FK) each being subject to subcarrier-specific disturbances (ici0) caused by subcarriers (st1...n) arranged adjacent in the frequency domain,
- 15 characterized
- in that the subcarriers (st1...n) of the received multicarrier signal (ms) are additionally deliberately subjected to disturbances,
 - 20 - in that correction information (ici_{opt}) which represents the subcarrier-specific disturbances (ici0) is derived from the subcarriers (st1...n) which have been additionally deliberately subjected to disturbances, and
 - 25 - in that the subcarriers (st1...n) of the received multicarrier signal (ms) are corrected in accordance with the determined correction information (ici_{opt}).
- 30 2. The method as claimed in claim 1, characterized
- in that a number of different test disturbances (icix) are provided, with the subcarriers (st1...n) being deliberately subjected to
- 35 disturbances, in the event of a test disturbance

(icix), by means of constant or frequency-dependent disturbance information (icil...4).

3. The method as claimed in claim 2,
5 characterized
- in that the received symbols (es1...n) which represent frequency-discrete subcarriers (st1...n) are derived from the received multicarrier signal (ms),
 - 10 - in that k differently defined reference disturbance information items (icil...4) are provided, in which case, for each reference disturbance information item (icil...4),

- 5 -- (a) the received symbols ($es1...n$) in the
 subcarriers ($st_{i,1}$, $st_{i,1}$) which are in
 each case arranged adjacent around at
 least some of the subcarriers (st_i) in
 the frequency domain are each subjected
 to disturbances from the reference
 disturbance information ($icil...4$), and
 the disturbed received symbols in the
 adjacent subcarriers ($st_{i,1}$, $st_{i,1}$) are
10 then additively superimposed as
 deliberate test disturbances ($icix_{i,1}$,
 $icix_{i,1}$) on the received symbol ($es1...n$)
 in the additionally disturbed subcarrier
 (st_i),
15 - (b) in that the additionally deliberately
 disturbed received symbols ($es'1...n$)
 are each compared with the closest
 modulation-specific modulation symbol,
 and subcarrier-specific error
20 information ($\Delta s1...n$) is formed as a
 function of the comparison results, and
 -- (c) disturbance-information-specific sum
 error information ($ses1...k$) is formed
 from the subcarrier-specific error
25 information ($\Delta s1...n$), and
 - (d) in that the correction information
 (ici_{opt}) is derived from the k reference
 disturbance information items ($icil...k$)
 and the k sum error information items
30 ($ses1...k$).

4. The method as claimed in claim 3,
 characterized

- 35 - in that the frequency-discrete received symbols
 ($es1...n$) derived from the received
 multicarrier signal (ms) are delayed or are

temporarily stored until the correction information (ici_{opt}) has been established,

- 5 - (e) in that the delayed received symbols ($ves1...n$) in the subcarriers (st_{i-1} , st_{i+1}) which are in each case arranged adjacent around a subcarrier (st_i) in the frequency domain are each corrected by the determined correction information (ici_{opt}), and are then additively
10 superimposed on the delayed received symbol ($ves1...n$) in the subcarrier (st_i).

5. The method as claimed in claim 3 or 4,
characterized

in that the k reference disturbance information items (icil...k) and the k disturbance-information-specific sum error information items (se1...k) derived from them are used to establish a correction function (KF) which is used to calculate the correction information (ici_{opt}).

6. The method as claimed in claim 5,
characterized

- in that four defined reference disturbance information items (icil...4) are provided, and are used to derive the four disturbance-information-specific sum error information items (se1...4) and
- in that the correction information (ici_{opt}) is calculated by

$$ici_{opt} = \left(\frac{se4 - \frac{(se1 + se3)}{2}}{2(se1 - se3)} \right) \cdot (ici1 - ici3) + \frac{ici4}{2}$$

where

se1...4 represents the four sum error information items (se1...4), and
icil...4 represents the four reference disturbance information items (icil...4).

7. The method as claimed in claim 3 or 4,
characterized

in that the correction information (ici_{opt}) is determined in the course of an iterative search, with the k reference disturbance information items (icil...4) being established in the course of the iterative search, and the steps (a) to (c) being

repeated until a minimum value of the disturbance-information-specific sum error information (ϵ_{\min}) is determined, and the correction information (ici_{opt}) has been derived from this.

8. The method as claimed in one of claims 3 to 7,
characterized

5 in that the additionally deliberately disturbed
received symbols ($es'1...n$) are in each case
corrected by equalization as a function of
frequency-selective transmission characteristics
($H(f)$) of the transmission medium (FK) before the
comparison with the respective closest modulation-
specific modulation symbol.

10

9. The method as claimed in one of claims 3 to 8,
characterized

- in that, once steps (a) to (d) have each been
carried out for each reference disturbance
15 information item ($icil...4$)

-- (a') the received symbols ($es1...n$) of the
subcarriers ($st_{1,b}$, $st_{1,b}$, where $b > 1$)
which are each arranged further away
from at least some of the subcarriers
20 (st_i) in the frequency domain are each
subjected to disturbances from the
reference disturbance information
($icil...4$), and the disturbed received
symbols are then additively superimposed
25 as deliberate test disturbances ($icix_{1,}$,
 $icix_{1,}$) on the received symbol ($es1...n$)
of the additionally disturbed subcarrier
(st_i), and

-- steps (b) to (d) are then carried out.

30

10. The method as claimed in one of claims 2 to 9,
characterized

- in that the received symbols ($ves'1...n$) which
have been corrected using the correction
35 information (ici_{opt}) are demodulated,,

- in that errors are identified in the demodulated received symbols (d_i) using error identification information inserted into the transmitted information, and identified, erroneous received symbols ($es'1...n$, $es''1...n$) are corrected,
- in that, when errors are identified, steps (b) to (d) are carried out once again, with the corrected received symbols ($es'1...n$, $es''1...n$) being used for determining the correction information (ici_{opt}).

11. The method as claimed in one of the preceding claims,
characterized
in that the multicarrier method is provided by
means of an OFDM transmission method - Orthogonal
Frequency Division Multiplexing - or by means of a
transmission method based on discrete multiple
tones - DMT.
12. The method as claimed in one of the preceding claims,
characterized
in that the transmission medium is in the form of
a wireless radio channel or a cable-based or wire-
based transmission channel.
13. The method as claimed in claim 12,
characterized
in that the information is transmitted via power
supply lines.
14. Use of the method according to the invention as
claimed in one of the preceding claims,
characterized
- in that the received multicarrier signal (ms)
is demodulated,
 - in that errors contained in the demodulated
multicarrier signal (di) are identified using
an error handling routine and are corrected,
 - in that the method is carried out in order to
deliberately disturb the received multicarrier
signal (ms) as a function of the number and
correctability of the errors.
15. A receiving arrangement for receiving a
multicarrier signal (ms) having a number of

frequency-discrete subcarriers (st1...n) and into
which information is inserted which is converted
into frequency-discrete modulation symbols by
means of a multicarrier method,
5 with the individual frequency-discrete subcarriers
(st1...n) of the multicarrier signal (ms)
transmitted via a transmission medium (FK) each
being subject to subcarrier-specific disturbances
(ici0)

10

caused by subcarriers (st1...n) arranged adjacent in the frequency domain, characterized

- 5 - in that disturbance means (RM1..4) are provided for additional, deliberate disturbance of the received multicarrier signal (ms),
- 10 - in that means (ASW) are arranged for deriving correction information (ici_{opt}), which represents the subcarrier-specific disturbances ($ici0$), from the additionally deliberately disturbed subcarriers (st1...n, es'1...n, es''1...n), and
- 15 - in that means (KE) are provided for correction of the frequency-discrete subcarriers (st1...n, ves1...n) as a function of the determined correction information (ici_{opt}).

Abstract

Method, use of the method and a receiving arrangement for receiving multicarrier signals having a number of frequency-discrete subcarriers

In a received multicarrier signal (ms) which is subject to subcarrier-specific disturbances (ici_0) caused by adjacent subcarriers ($st1...n$), the subcarriers ($st1...n$) are additionally deliberately subjected to disturbances, and correction information (ici_{opt}) which represents the carrier-specific disturbances (ici_0) is derived from the subcarriers ($st1...n$) which have been additionally deliberately subjected to disturbances and is then used to correct the received subcarriers ($st1...n$). Low-cost oscillators can advantageously be used to provide cheap transmitting and receiving units.

FIG 2